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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A cross-linkable and/or cross-linked nanofiller composition which comprises a cross-linkable and/or cross-linked ethylene (co)polymer and an intercalated nanofiller.
2. A composition according to claim 1, in which the ethylene (co)polymer is selected from polyethylene and ethylene based alkene or alphaolefin copolymers.
3. A composition according to claim 1 or claim 2, in which the ethylene (co)polymer is high density polyethylene (HDPE), medium density polyethylene (MDPE), linear low density polyethylene (LLDPE), low density polyethylene (LDPE), very low density polyethylene (VLDPE), ultra low density polyethylene (ULDPE), an ethylene hexene copolymer, an ethylene octene copolymer, a butylene (co)polymer, an ethylene-propylene copolymer (EPM), an ethylene-propylene-diene terpolymer (EPDM), an ethylene-butylene copolymer (EBM) or terpolymer (EBDM), an ethylene-vinylsilane (co)polymer, a copolymer or terpolymer of ethylene with acrylic acid (EA) or ethylene with ethylene acrylate and acrylic acid (EAA) or methacrylic acid (EMA) and/or a copolymer of ethylene with ethylacrylate (EEA), butyl-acrylate (EBA) or vinyl acetate (EVA).
4. A composition according to claim 3, in which the butylene (co)polymer is polybutylene or polyisobutylene.
5. A composition according to any one of claims 1 to 4, in which the ethylene (co)polymer is in the form of a metallocene catalyst ethylene (co)polymer.
6. A composition according to any one of claims 1 to 5, in which the ethylene (co)polymer or part thereof is

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grafted with compounds containing carboxylic acid or anhydride group(s).

7. A composition according to claim 6, in which the
5 carboxylic acid or anhydride group is maleic anhydride or acid or fumaric anhydride or acid.

8. A composition according to claim 6 or claim 7,
10 in which the grafted ethylene (co)polymer is a maleic anhydride (MAH) or maleic acid grafted copolymer.

9. A composition according to claim 8, in which the
maleic anhydride (MAH) or maleic acid grafted copolymer is
15 LDPE-MAH, LLDPE, HDPE-MAH, EP-MAH, EPR-MAH, PE-MAH or PP-MAH.

10. A composition according to any one of claims 1
to 9, in which the ethylene (co)polymer contains polar
20 group(s).

11. A composition according to claim 10, in which
the polar group(s) are carboxylic group(s), maleic
group(s) and/or ester group(s).

12. A composition according to claim 10 or claim 11,
25 in which the amount of (co)polymer with polar group(s) is about 0.01% of the total (co)polymer.

13. A composition according to any one of claims 10
30 to 12, in which the amount of (co)polymer with polar group(s) is about 0.5% of the total (co)polymer.

14. A composition according to any one of claims 10
to 13, in which the amount of (co)polymer with polar
35 group(s) is at least about 5% of the total (co)polymer.

15. A composition according to any one of claims 10
to 14, in which the amount of (co)polymer with polar

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group(s) is at least about 8% of the total (co)polymer.

16. A composition according to claim 3, in which the ethylene content of the ethylene-propylene copolymer is
5 about 10 to about 99.9% by weight.

17. A composition according to claim 3 or claim 16, in which the ethylene content of the ethylene-propylene copolymer is about 40 to about 99.9% by weight.
10

18. A composition according to any one of claims 3, 16 and 17, in which the ethylene content of the ethylene-propylene copolymer is about 75 to about 99.9% by weight.

15 19. A composition according to claim 3, in which the vinyl acetate content of the ethylene-vinyl acetate copolymer (EVA) is about 3 to about 80% by weight.

20. A composition according to claim 3 or claim 19,
20 in which the vinyl acetate content of the ethylene-vinyl acetate copolymer (EVA) is about 9 to about 70% by weight.

21. A composition according to any one of the preceding claims, in which the ethylene (co)polymer is a
25 plastomer or an elastomer.

22. A composition according to claim 21, in which at least about 40% to about 50% by weight of the total weight of (co)polymer is a plastomer with the balance being an
30 elastomer.

23. A composition according to claim 21 or claim 22, in which at least about 60% by weight is a plastomer with the balance being an elastomer.
35

24. A composition according to any one of claims 21 to 23, in which the plastomer is HDPE, MDPE, LDPE, LLDPE,

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VLDPE, EVA with up to about 30% vinyl acetate, EPM with up to about 25% propylene and/or an ethylene octene copolymer with S.G. of at least about 0.887.

5 25. A composition according to any one of claims 21 to 24, in which the elastomer is an ethylene octene copolymer with a S.G. of up to about 0.887, an ethylene hexene copolymer, ULDPE, ethylene propylene copolymer, an
10 38% vinyl acetate, EPDM, EPM, and/or EPR.

26. A composition according to claim 25, in which the ethylene propylene copolymer is a terpolymer with a
15 propylene co-monomer of greater than about 30%.

27. A composition according to claim 35, in which the vinyl acetate content for plastomeric EVA is about 9 to about 30% by weight.

20 28. A composition according to claim 25, in which the vinyl acetate content for elastomeric EVA is about 38 to about 50% by weight.

29. A composition according to any one of the
25 preceding claims, in which the cross-linkable and/or cross-linked ethylene (co)polymer forms at least about 40% by weight of the total weight of (co)polymer.

30. A composition according to any one of the
30 preceding claims, in which the nanofiller has particle(s) in the order of size of less than 50nm.

31. A composition according to any one of the
preceding claims, in which the thickness of the nanofiller
35 particles is about 1nm to about 100nm.

32. A composition according to any one of the

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preceding claims, in which the diameter or length or width of the nanofiller is up to about 500nm.

33. A composition according to any one of the
5 preceding claims, in which the layers of the nanofiller are composed of silicate.

34. A composition according to any one of the
preceding claims, in which the nanofiller is intercalated
10 with an organic intercalatent.

35. A composition according to claim 34, in which the organic intercalatent is an ionic or polar compound(s).
15

36. A composition according to claim 35, in which the ionic or polar compound(s) is a quaternary ammonium salt.

20 37. A composition according to claim 36, in which the quaternary ammonium salt is an optionally substituted long chain hydrocarbon quaternary ammonium salt.

38. A composition according to claim 37, in which
25 the optionally substituted long chain hydrocarbon quaternary ammonium salt is a benzyl or alkyl substituted long chain hydrocarbon quaternary ammonium salt, an alkyl substituted tallow or hydrogenated tallow quaternary ammonium salt and/or a bis-hydroxyethyl quaternary
30 ammonium salt.

39. A composition according to any one of claims 36 to 38, in which the counter anion for the quaternary ammonium cation is a halide or methyl sulphate.
35

40. A composition according to any one of the preceding claims, in which the nanofiller is an

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intercalated mineral nanofiller or clay which is either synthetic or natural and has been intercalated by organic modification with ionic or polar substances.

5 41. A composition according to claim 40, in which the mineral or clay is montmorillonite, bentonite, smectite and/or phyllosilicate.

42. A composition according to claim 40 or claim 41,
10 in which the nanofiller is Cloisite, Nanofil, Tixogel or Kunipia.

43. A composition according to any one of the preceding claims, in which the amount of nanofiller is
15 about 0.1 to about 15% by weight.

44. A composition according to claim 43, in which the amount of nanofiller is about 1 to about 10% by weight.

20 45. A composition according to claim 43 or claim 44, in which the amount of nanofiller is about 2 to about 6% by weight.

25 46. A composition according to any one of claims 35 to 45, in which the amount of organic intercalatent is up to about 40% by weight of the nanofiller.

47. A composition according to any one of the
30 preceding claims, which further comprises another filler.

48. A composition according to claim 47, in which the filler is an inorganic and/or mineral filler.

35 49. A composition according to claim 47 or claim 48, in which the filler is an optionally calcined clay, talc, mica, kaolin, alkaline earth metal carbonate, and/or metal

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hydroxide.

50. A composition according to claim 49, in which the alkaline earth metal carbonate is calcium carbonate, magnesium calcium carbonate and/or hydrated basic
5 magnesium carbonate.

51. A composition according to claim 49, in which the metal hydroxide is aluminum and/or magnesium
10 hydroxide.

52. A composition according to any one of claims 47 to 51, in which the filler is coated.

15 53. A composition according to claim 52, in which the filler is coated with stearic acid, stearate, silane, siloxane and/or titanate.

54. A composition according to any one of the
20 preceding claims, which further comprises an organic silane grafted to the ethylene (co)polymer and/or intercalated into the nanofiller.

55. A composition according to claim 54, in which
25 the organic silane is a vinyl silane and/or a long aliphatic hydrocarbon chain silane.

56. A composition according to claim 55, in which
the vinyl silane is a vinyl alkoxy silane.

30

57. A composition according to claim 56, in which the vinyl alkoxy silane is vinyl-tris-methoxy-silane (VTMOS), vinyl-tris-methoxy-ethoxy-silane (VTMEOS), vinyl-tris-ethoxy-silane, vinyl-methyl-dimethoxy-silane and/or
35 gama-methacryl-oxypropyl-tris-methoxy-silane.

58. A composition according to any one of claims 55

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to 57, in which the vinyl silane is added in an amount from about 0.5 to about 2% by weight.

59. A composition according to claim 58, in which
5 the vinyl silane is added in an amount of about 0.8 to about 2.0% by weight.

60. A composition according to claim 58 or claim 59,
10 in which the vinyl silane is added in an amount of about 1% to about 1.8% by weight.

61. A composition according to any one of claims 54
to 60, in which the organic silane is grafted using a free
radical initiator.

15

62. A composition according to claim 61, in which
the free radical initiator is a peroxide.

63. A composition according to claim 62, in which
20 the peroxide is dicumyl peroxide, di-tertiary-butyl peroxide, di-tertiary-butyl-cumyl peroxide and/or bis-tertiary-butyl-cumyl peroxide.

64. A composition according to any one of claims 61
25 to 63, in which the free radical initiator is added in an amount of about 0.05 to about 0.3% by weight.

65. A composition according to any one of claims 61
to 64, in which the free radical initiator is added in an
30 amount of about 0.15 to about 0.2% by weight.

66. A composition according to any one of the
preceding claims, in which the composition and/or ethylene
(co)polymer are silane cross-linked, cross-linked by
35 adding a cross-linking catalyst or radiation cross-linked.

67. A composition according to any one of the

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preceding claims, which further comprises one or more additives known in the art of polymer processing.

68. A composition according to claim 67, in which
5 the additive is an antioxidant, metal deactivator, copper inhibitor, UV absorber, foaming or blowing agent which is either endothermic or exothermic, processing and/or thermal stabiliser, pigment, flame retardant, extender, plasticiser and/or softener.

10

69. A process for preparing a cross-linkable and/or cross-linked nanofiller composition which comprises either:

(a) mixing and delaminating and/or exfoliating
15 in one step a cross-linkable ethylene (co)polymer and an intercalated nanofiller;

(b) mixing a cross-linkable ethylene (co)polymer with an intercalated nanofiller; and delaminating and/or exfoliating at least

20 part of the nanofiller; or

(c) delaminating and/or exfoliating at least part of an intercalated nanofiller; and

25 mixing the delaminated and/or exfoliated intercalated nanofiller with a cross-linkable ethylene (co)polymer.

70. A process according to claim 69, in which the ethylene (co)polymer and/or nanofiller are subjected to grafting either before, during or after the mixing and/or
30 exfoliating and/or delaminating step(s).

71. A process according to claim 70, in which the grafting involves treating the ethylene (co)polymer and/or nanofiller with an organic silane which is then grafted
35 onto the (co)polymer and/or intercalated into the nanofiller.

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72. A process according to claim 71, in which the organic silane is grafted using a free radical initiator.

73. A process according to any one of claims 69 to 72, which further comprises the step of cross-linking the (co)polymer after step (a) or cross-linking the composition after step (b) or (c).

74. A process according to claim 73, in which the composition and/or ethylene (co)polymer is silane cross-linked, cross-linked by adding a peroxide cross-linking agent or radiation cross-linked.

75. A process according to any one of claims 69 to 74, in which the (co)polymer is granulated, pelletised, powderised, cut and/or diced.

76. A process according to any one of claims 69 to 75, in which the (co)polymer and the nanofiller are pre-mixed or added simultaneously, sequentially and/or separately to a mixing apparatus.

77. A process according to any one of claims 69 to 76, in which the nanofiller or composition are exfoliated and/or delaminated using high shear processing.

78. A process according to any one of claims 69 to 77, in which a further exfoliation and/or delamination step is performed at any stage of the process.

79. A process according to any one of claims 69 to 78, in which other fillers and/or additives are added simultaneously, sequentially and/or separately at any step of the process.

80. A process according to claim 79, in which the (co)polymer, nanofiller, other fillers and/or additives

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are dry or dried in a separate step prior to step (a).

81. An article which is wholly or partly composed of
the nanofiller composition defined in any one of claims 1
5 to 68.

82. An article according to claim 81, which is a
profile, tube, pipe, film, sheet, tile, floor covering,
container or packaging for food.
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83. A process for preparing the article defined in
claim 81 or claim 82, which comprises either:

(a) forming or shaping the nanofiller
composition defined in any one of claims 1 to 68; or
15 (b) combining at least one layer of the
nanofiller composition defined in any one of claims 1 to
68 with at least one other polymeric layer;

(c) cross-linking the nanofiller composition
defined in any one of claims 1 to 68; or

20 (d) heating and stretching the nanofiller
composition defined in any one of claims 1 to 68 and
cooling the stretched composition.